



### Pump Design

The above photo shows a technician of Sundstrand Corporation's Fluid Handling Division, Arvada, Colorado installing a titanium impeller on a Sundstrand centrifugal pump. NASA technological information proved useful in improving the company's line of pumps and compressors employed by petroleum and chemical processing firms.

Titanium is frequently used in high-speed pump and compressor components, particularly in parts subjected to corrosive or erosive fluids. A Sundstrand engineer, interested in acquiring more information on the corrosion resistance and strength characteristics of titanium, learned of a NASA handbook on a general purpose titanium alloy; typically used in aircraft and missile structures, the alloy is highly resistant to the corroding effects of salt water, many acids, alkalis and other chemicals. Developed by Marshall Space Flight Center, the handbook provides comprehensive detail on the properties of the alloy, including corrosion and other environmental effects, together with information on fabrication and joining techniques. Sundstrand obtained the handbook and used it in design calculation for casting titanium impellers. The company reports that NASA information contributed substantially to improved impeller design.

### Testing Composites

Growing aerospace use of composite materials prompted Lewis Research Center to look for better ways of testing composites for strength characteristics. Ultrasonics, a proven method of testing metals, was considered unsuitable for testing composites; it might show the structure free of defects when in fact the structure's strength was inadequate due to faulty fabrication or deterioration over time. Seeking a nondestructive method that would detect flaws and also evaluate a composite material's strength and endurance, Lewis came up with a system that combines a proven technique—ultrasonics—with a relatively new technique known as acoustic emission testing. In this system, ultrasonic "stress waves" are injected into a composite structure. As the stress waves propagate through the material, their character is affected by the same factors that influence the material's strength properties. Thus, analysis of how the stress wave is affected provides a basis for predicting composite material strength and response to stresses.

Shown being used to examine a composite sample (below), the Lewis-developed Acoustic Emission/Ultrasonic Test Instrument is produced by Acoustic Emission Technology Corporation, Sacramento, California. Designated the Model 206AU, the lightweight, portable system has three main sections. The "pulser" section injects ultrasonic waves into the material under test. A receiver picks up the simulated stress waves as they pass through the material and relays the signals to the acoustic emission section, where they are electronically analyzed. In the display section, flaw and strength assessment information is presented simultaneously in both graphic and digital form.

